

ECOLOGICAL NOTES ON THE PINE MIDGES *RETINODIPLOSIS*
RESINICOLA (OSTEN SACKEN) AND *R. INOPIS*
(OSTEN SACKEN) IN SOUTHERN OHIO

(DIPTERA, TONIDIDAE)

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The midges *Retinodiplosis resinicola* (Osten Sacken) and *R. inopis* (Osten Sacken) develop in masses of resin on pine twigs (fig. 1) in aggregations of several individuals to a mass. Occasionally their feeding becomes of economic importance (Barnes, 1951). The two species were studied in southern Ohio mainly in the Shawnee State Forest during three growing seasons from 1951 through 1953.

Midge adults in this study were identified by R. H. Foote of the Insect Identification and Parasite Introduction Section, U. S. Department of Agriculture. Parasites were identified by specialists of the same section as follows: Pteromalidae and Eupelmidae, B. D. Burks; Platygasteridae, C. F. W. Muesebeck.

INCIDENCE

Retinodiplosis spp. adults were reared or their larvae were seen developing at several widely scattered localities in southern Ohio. These insects probably occur throughout the ranges of their host pines in Ohio. Authentically identified specimens of *R. resinicola* and *R. inopis* were reared from pitch pine, *Pinus rigida* Miller, and specimens of *R. inopis* were reared from Virginia pine, *Pinus virginiana* Miller. These determinations were made with male specimens because females of the two species cannot be reliably differentiated (Barnes, 1951). Sample specimens sent to the identifier proved to be mainly females. Both midges occurred in the same pine stands, but *R. inopis* was less abundant than *R. resinicola*.

At a time when developing maggots were abundant, aggregations were examined for size and age of that part of the host supporting them. Aggregations were found on pitch pine twigs, branches, and trunks up to 2 inches in diameter and up to 5 years old. Many more twigs than branches and more branches than trunks were infested. Pitch pine trees from 2 to approximately 12 feet in height were seen supporting dense maggot populations.

INJURY

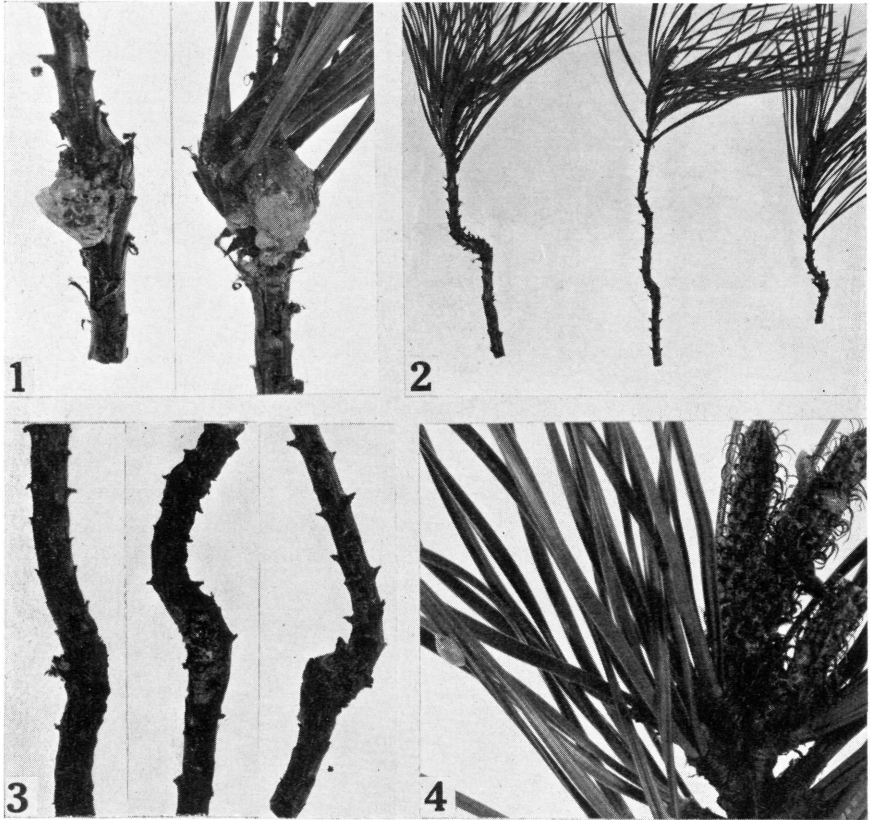
Exactly what the maggots eat is still not clear. Barnes (1951) has reviewed the available information on this subject. Infestation causes swellings and distortions on young twigs (fig. 1, 2, 3) and probably a reduction in the vigor of the tree. Healed feeding places on older stems form resin pockets in the wood ("bird's-eye pine"). Twigs and even trees are said to be killed in severe infestations (Barnes, 1951), but no infested twigs in the Shawnee Forest died.

LIFE HISTORIES

Tracing the seasonal histories of the midges was difficult because of a marked decline in their abundance following emergence of the spring brood in May. The observations in table 1 suggest that approximately 4 broods a year are produced.

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The maximum number of broods per year may be greater; there is probably much overlapping of generations after May because of the long emergence period of the spring brood. The late summer and early spring observations (table 1) suggest that the winter is spent in the larval stage. Moreover, typical *Retinodiplosis* larval aggregations on pitch pine were seen during the winter in the vicinity of Washington, D. C. Other observers have also given the larval stage as the wintering form (Barnes, 1951).



EXPLANATION OF FIGURES 1-4

1. Resin masses of *Retinodiplosis* sp. probably *inopis* on pitch pine twigs. Needles were removed for the photograph.
2. Pitch pine twigs one year after deformation by *Retinodiplosis* sp. probably *inopis*. Needles were removed for the photograph.
3. Pitch pine twigs two years after deformation by *Retinodiplosis* sp. probably *inopis*.
4. Resinous cocoons of *Retinodiplosis inopis* on buds and needles of pitch pine.

The resin masses inhabited by *R. resinicola* frequently were larger, contained more individuals, and occurred on larger stems than the masses of *R. inopis*. *R. resinicola* masses were usually opalescent while *R. inopis* masses were often transparent. In 24 aggregations examined in the spring, the number of nearly or fully grown *Retinodiplosis* spp. larvae and pupae per aggregation varied from 2 to 29, with the mode being 5.

The larvae of *R. resinicola* pupated in silken cells spun within their resin masses. These cells protected the pupae from the sticky resin. Pupae were oriented with

their heads outward from the mass. Just before emergence of adults, the pupae worked themselves about half way out of their cells by manipulating their abdomens. Following adult emergence, the empty pupal skins protruded from resin masses.

In contrast to *R. resinicola*, the larvae of *R. inopis* crawled away from their resin masses and pupated in resinous cells elsewhere on the twig (fig. 4). Barnes (1951) mentioned the different pupating habits of the two species as diagnostic characters.

R. resinicola and *R. inopis* adults of the spring brood emerged concurrently in the insectary in May. Spring insectary emergence began in 1952 on May 4, and in 1953 on May 3. The flies issued over periods ranging from 24 to 38 days. Adults were short lived. Sixteen *R. resinicola* individuals which had emerged during the previous 24 hours were put in a battery jar. The following day, half of the midges in the jar were dead, and two days later, all but three were dead. There had also been placed in the jar a freshly cut pine twig and three microscope slides each containing a droplet of fresh resin. During the first 24 hours, the

TABLE 1
Seasonal history observations on *Retinodiplosis* spp. in
southern Ohio

Date	Observation
April 2, 1953	Full grown larvae.
April 16	Partially grown larvae.
April 30	Full grown larvae.
May 7	Pupae
May 14	Pupae and full grown larvae.
May 28	Pupae and empty pupal cases.
June 19	Full grown larvae.
July 1, 1952	Pupae and empty pupal cases.
July 9, 1953	Full grown larvae.
July 30	Do.
September 3	Do.

confined midges laid several hundred eggs. The midges were attracted to the resin for oviposition, a fact well brought out earlier by Eckel (1903). Some of the eggs were laid in the resin on the slides, and many on the cut ends of the twig where resin had exuded; but most were laid on the walls of the jar where almost imperceptible traces of resin had been deposited accidentally in handling.

PARASITIZATION

Emergence records from randomly collected aggregations of both species of *Retinodiplosis* during the springs of 1952 and 1953 showed that 15 percent of the midges were parasitized. Listed in descending order of their abundance, the parasites (all hymenopterous) were *Systasis diplosidis* Eckel, *Habrocytus* sp., *Norbanus* sp. (Pteromalidae); *Platygaster diplosidis* (Ashmead) (Platygasteridae); and *Eupelmus* sp. (Eupelmidae). Definite associations of parasites with host species were noted for only two of the parasites: *Systasis diplosidis* on *Retinodiplosis resinicola* and *Platygaster diplosidis* on *Retinodiplosis inopis*. Eckel (1903) found *Systasis diplosidis*, a *Eupelmus* sp., and *Platygaster diplosidis* parasitizing *Retinodiplosis resinicola* in Massachusetts.

Systasis diplosidis accounted for about three-fourths of all parasitization. This parasite appeared in the insectary all three rearing years. It was solitary in its development and apparently did not affect all individuals in a host aggrega-

tion. Besides emerging in spring, it is known to have developed on at least one later host generation. Adults began issuing in spring during the last one-third to one-fourth of the host emergence period. Of 30 parasite specimens obtained from several maggot aggregations, 19 were males and 11 females.

Habrocytus sp. accounted for most of the remaining parasitization. This parasite emerged concurrently with *Systasis diplosidis*. Of 7 *Habrocytus* sp. individuals picked at random for identification, 3 were males and 4 females.

Two aggregations of *Platygaster diplosidis* issued in the insectary on May 11, 1953, through several round holes gnawed by the adults in their *Retinodiplosis inopis* cells. These aggregations numbered 9 and 10 adults. Before parasite emergence, the host cells looked black because of the dark color of the parasites inside them.

Two females of *Norbanus* sp. emerged on May 31, 1953, and one female of *Eupelmus* sp. on May 25, 1953.

ANNUAL POPULATION FLUCTUATION

For three years it was consistently observed that aggregations of developing *Retinodiplosis resinicola* midges were abundant in the spring, but scarce during the remainder of the growing season. This annual fluctuation correlates with availability of potential development sites, a factor which seems to be determined by the host growing schedule.

In southern Ohio, pitch pine undergoes its most rapid growth in early spring. At this time, twigs swell and many tiny lesions frequently form in the bark of young trees. Small amounts of resin exude from these lesions. Eckel (1903) showed that minute exudates are ideal for the establishment of young *R. resinicola* maggots. That the midges are attracted to such exudates for oviposition seems well established by Eckel's work and the insectary observations just described. Thus potential development sites are abundant early in the spring when the overwintering brood emerges and begins ovipositing. Consequently, the population level of the following generation soars. By the time members of this large brood are ready to oviposit, however, conditions have changed. Host growth is slower and earlier lesions have healed or the exudates have hardened. As a result, fewer potential development sites are available and population levels drop. The same fluctuation can be inferred from Eckel's paper on *R. resinicola* in Massachusetts. The extent to which this phenomenon occurs in *R. inopis* is not known.

An experiment was done to test the hypothesis that this annual fluctuation in the Shawnee Forest is due mainly to availability of potential development places. On July 9, 1953, a date when maggots were hard to find, roadside pitch pine saplings at two midge focal points were blazed liberally with a pocket knife. Three weeks later resin exudates from these blazes were examined, and many small aggregations of maggots were found. Not all of the exudates contained insects, but the results clearly supported the hypothesis.

A spatial rather than temporal rhythm in abundance of a western species of *Retinodiplosis* was correlated by Austin et al. (1945) with presence or absence of natural resin exudation from shoots of different ponderosa pine trees in the same stand. Trees whose shoots were viscid with resin exudation were heavily infested whereas those whose shoots were not viscid were lightly infested.

During the summers, when *R. resinicola* population levels in the Shawnee Forest were low, the midges were found developing mostly in resin exudates caused by other insects or by unknown agencies. Resin masses of previous midge generations were never found harboring new aggregations. Two insect species providing habitations in which midges were observed developing were the pitch pine tip moth, *Rhyacionia rigidana* (Fernald), and the Virginia pitch-nodule moth, *Petrova wenzeli* (Kearfott) (= *P. virginiana* (Busck)). Also, Comstock

(1880) noted that the maggots occurred in exudates associated with the pitch twig moth, *P. comstockiana* (Fernald).

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